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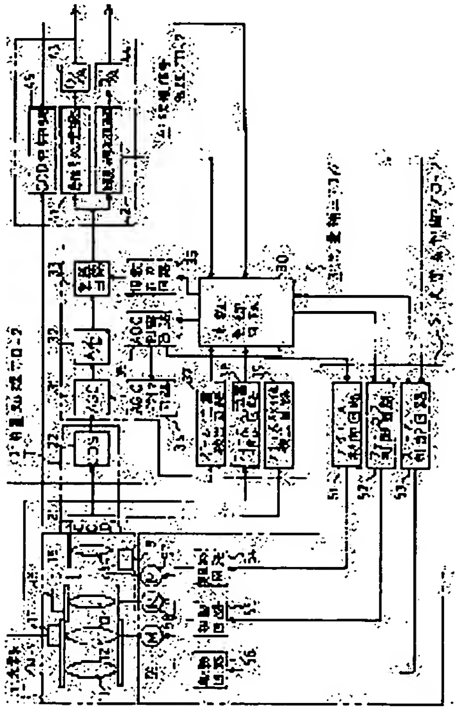
(54) LIGHT QUANTITY CORRECTOR

(57)Abstract:

PURPOSE: To provide satisfactory picture quality by completely correcting the quantity of light on the image forming plane of an image forming device without being affected by the shape and configuration of an optical system by providing a converting means for converting the quantity of light on the image forming plane to an electric signal and outputting a video signal.

CONSTITUTION: The quantity of light on the image forming plane of the image pickup device is converted to the electric signal by a CCD control circuit 45 and a CCD 21, the video signal is outputted, and the video signal is corrected by a light quantity correction block 3 based on the position of a focus lens detected by a focus position sensor 16, the position of a zoom lens detected by a zoom position sensor 17 and the diaphragming value of an iris detected by an iris diaphragming value sensor 18. Thus, the quantity of light on the image forming plane of the image pickup device can be completely corrected, and satisfactory picture quality can be provided. Further, since the quantity of light is electrically corrected, the device can be applied to any compact optic system as well and miniaturized without being affected by the shape and configuration of an optical syste lens or the like.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the quantity of light compensator of the video camera equipped with the focal lens, the zoom lens, and the iris about a quantity of light compensator.
[0002]
[Description of the Prior Art] While a video camera generally spreads in recent years, a miniaturization and high-definition-izing of equipment are demanded strongly.
[0003] The quantity of light compensator of the conventional video camera is explained below. Drawing 8 is the blo diagram showing the quantity of light compensator of the conventional video camera.
[0004] Optical-system control block 5 control the quantity of light amendment block 3 which a quantity of light compensator amends the video signal acquired by the optical-system block 1 which processes the inputted light optically, the front-end processing block 2 which change into an electric video signal the light picturized by the optic system block 1, and front-end processing block 2 in drawing, and amends the quantity of light equivalent, the video-signal processing block 4 which divide a video signal into a chrominance signal and a luminance signal, and optical-system block 1 contains.
[0005] In said optical-system block 1, the light from a photographic subject passes along the front lens 11 fixed to th camera cone, the zoom lens 12 which adjusts the field angle of the screen to picturize, the focal lens 13 which adjust the focus of incident light, the iris 15 which adjusts the quantity of light of incident light, and the compensator lens 1 fixed to the camera cone, and optical processing is performed to it, and it carries out image formation on CCD (Char Coupled Device)21.
[0006] Next, in the front-end processing block 2, the light picturized by CCD21 is changed into an electric signal fro an optical signal, and correlation duplex sampling processing is carried out and it is outputted as a video signal in the CDS (the abbreviation for correlation duplex sampling) circuit 22. In the optical amendment block 3, said video sign has the level of a signal amended by the AGC (the abbreviation for automatic gain control) circuit 31, and is changed into a digital signal from an analog signal by A/D converter 32. The video signal changed into the digital signal is inputted into the chrominance-signal processing circuit 41 and the luminance-signal processing circuit 42 of the vide signal processing block 4, is divided into a chrominance signal and a luminance signal, is changed into an analog sig from a digital signal by D/A converter 43 and D/A converter 44, and, finally is recorded on a magnetic tape etc. by them.
[0007] Next, focal actuation is explained. The focal location sensor 16 and the focal location detector 38 detect the location of the focal lens 13. The focal position control signal which controls the focal lens 13 for the detected focal position signal and the luminance signal outputted from the luminance-signal processing circuit 42 in the optimal location based on delivery, a focal position signal, and a luminance signal to the focal control circuit 52 is outputted the drive circuit 55 of the focal motor 58, the focal motor 58 is driven, and the focal lens 13 is controlled in the optim location. Focal actuation is performed by the above actuation.
[0008] Next, zoom actuation is explained. The zoom location sensor 17 and the zoom location detector 37 detect the location of a zoom lens 12. The zoom position control signal which controls a zoom lens 12 for the detected zoom position signal and the luminance signal outputted from the luminance-signal processing circuit 42 the optimal based on delivery, a zoom position signal, and a luminance signal to the zoom control circuit 53 is outputted to the drive

circuit 56 of the zoom motor 59, the zoom motor 59 is driven, and a zoom lens 12 is controlled in the optimal locatio Zoom actuation is performed by the above actuation.

[0009] Next, iris adjustment actuation and quantity of light amendment actuation are explained. The iris diaphragm value sensor 18 and the iris diaphragm value detector 39 detect the drawing value of an iris 15, and the detected iris diaphragm value signal and the luminance signal outputted from the luminance-signal processing circuit 42 are sent the AGC control circuit 35. When an iris 15 can adjust the amount of incident light not by the full open condition bu by the iris 15, the AGC control circuit 35 An AGC control signal with which the gain of AGC circuit 31 is set to 0 is outputted to the AGC drive circuit 34. The drawing value of the iris 15 from which the video signal by AGC circuit 3 is not adjusted, but the level of a video signal becomes the optimal to the iris control circuit 51 Delivery, The iris control circuit 51 outputs an iris control signal to the drive circuit 54 based on this drawing value, and by driving the iris motor 57, an iris 15 is controlled so that the level of a luminance signal becomes the optimal. Next, when an iris is opened fully and the amount of incident light cannot be adjusted with an iris 15, the AGC control circuit 35 output an AGC control signal with which the level of a luminance signal becomes the optimal to the AGC drive circuit 34, controls the gain of AGC circuit 31, and adjusts the level of a video signal. By the above actuation, iris adjustment a quantity of light amendment are performed, and the level of a luminance signal is adjusted to the optimal condition.

[0010]

[Problem(s) to be Solved by the Invention] Generally, as for the quantity of light of the image formation side picturiz using the lens, the iris, etc., the brightness of a periphery becomes dark from the brightness of the center section of th image formation side. This phenomenon is generated by photometry-the 4th power rule of cosine and a vignetting. T fall of the quantity of light by the 4th power rule of cosine is generated when the include angles of an effectual focal distance and an image formation side differ by the center section and periphery of an image formation side, and since the light which carries out image formation to the periphery of an image formation side is interrupted with protection from-light objects, such as a camera cone of a lens, the fall of the quantity of light by the vignetting is generated.

[0011] The fall of the above-mentioned amount of ambient light has the problem of causing degradation of the image quality of the periphery of the screen finally recorded.

[0012] In the conventional quantity of light compensator mentioned above, the quantity of light of the periphery of a image formation side was amended by the following approaches.

[0013] It is the approach of preventing the light which carries out image formation to the periphery of an image formation side being interrupted, by enlarging magnitude of each lens and mainly using the core of each lens from th magnitude of CCD21, as the 1st approach. By this approach, although the fall of the quantity of light by the vignettin could be controlled, since the quantity of light fall by the 4th power rule of cosine was not able to be controlled, the quantity of light fall of a periphery could not be amended completely, but image quality had deteriorated in the periphery of the screen finally recorded. Moreover, in order to enlarge a lens, it was difficult for the optical-system block 1 to become large and to attain the miniaturization of equipment.

[0014] Next, it is the approach of preventing the light which enlarges magnitude of each lens to the flux of light equivalent, and carries out image formation to the periphery of an image formation side being interrupted, by extract an iris 15 and making the whole flux of light thin as the 2nd approach. While the quantity of light fall by the 4th pow rule of cosine cannot be controlled but the image quality of the periphery of a screen deteriorates like [this approach the 1st approach, the whole quantity of light falls. Even if it amplified the whole quantity of light by AGC circuit 31, order to amplify to a noise component, S/N of a video signal deteriorated, and degradation of the image quality of th whole screen was caused.

[0015] Therefore, by the above-mentioned approach, degradation of the image quality by the fall of the amount of ambient light could not be solved fundamentally, but the image quality in the periphery of a screen was degraded.

[0016] In this invention, the trouble of the above-mentioned conventional quantity of light compensator is not solved and it is not influenced [the configuration of optical system, and] of a configuration, but the quantity of light of the image formation side of image formation equipment is amended completely, and it aims at offering the quantity of li compensator which can acquire good image quality.

[0017]

[Means for Solving the Problem] The focus control means with which the quantity of light compensator of this invention was equipped with the focal lens, A conversion means to be a quantity of light compensator the field angle adjustment means equipped with the zoom lens, and for the image pick-up equipments equipped with the iris which extract and form a photographic subject image in an image formation side including an adjustment means, and to change the quantity of light in an image formation side into an electrical signal, and to output a video signal, The 1st location detection means which detects the location of a focal lens, and the 2nd location detection means which detec the location of a zoom lens, Based on the detection data detected by diaphragm value detection means to detect the drawing value of an iris, the 1st location detection means, the 2nd location detection means, and the diaphragm value detection means, an amendment means to amend the video signal of a conversion means is included.

[0018]

[Function] Since the quantity of light compensator concerning this invention is constituted as mentioned above, with conversion means The location of the focal lens which changed the quantity of light of the image formation side of image pick-up equipment into the electrical signal, outputted the video signal, and was detected by the 1st location detection means, Based on the location of the zoom lens detected by the 2nd location detection means, and the drawi value of the iris detected by the diaphragm value detection means, the quantity of light of the image formation side o image pick-up equipment is amended by amending said video signal with an amendment means.

[0019]

[Example] Hereafter, one example of this invention is explained, referring to a drawing.

[0020] The block diagram of the quantity of light compensator which is one example of this invention is shown in drawing 1 . In drawing, a quantity of light compensator amends serially the video signal acquired by the optical-syst block 1 which processes optically the light which carried out incidence, the front-end processing block 2 which chan electrically into a video signal the light picturized by the optical-system block 1, and the front-end processing block The optical-system control block 5 which controls the quantity of light amendment block 3 which amends the quanti of light equivalent, the video-signal processing block 4 which divides a video signal into a chrominance signal and a luminance signal, and the optical-system block 1 is included.

[0021] In the optical-system block 1, the light from a photographic subject passes along the front lens 11 fixed to the camera cone, the zoom lens 12 which adjusts the field angle of the screen to picturize, the focal lens 13 which adjust the focus of incident light, the iris 15 which adjusts the quantity of light of incident light, and the compensator lens 1 fixed to the camera cone, and optical processing is performed to it, and it forms an image formation side on CCD21.

[0022] Next, in the front-end processing block 2, CCD21 is controlled by the CCD control circuit 45, changes the picturized light into an electric signal from an optical signal serially, carries out correlation duplex sampling processing, and outputs it as a video signal in the CDS circuit 22. In the quantity of light amendment block 3, said video signal has the level of a signal amended by AGC circuit 31, and is changed into a digital signal from an analog signal by A/D converter 32. The video signal changed into the digital signal the correction factor calculated in the multiplier control circuit 30 which consisted of a CPU (arithmetic and program control), the memory section, etc. It inputted into the chrominance-signal processing circuit 41 and the luminance-signal processing circuit 42 of the vide signal processing block 4 after multiplication is carried out in the multiplication circuit 33 through the multiplier out circuit 36. It is divided into a chrominance signal and a luminance signal, and it is changed into an analog signal from digital signal by D/A converter 43 and D/A converter 44, and, finally is recorded on a magnetic tape etc. by them.

[0023] Next, focal actuation is explained. The focal location sensor 16 and the focal location detector 38 detect the location of the focal lens 13. The focal position control signal which controls the focal lens 13 for the luminance sign outputted to the focal control circuit 52 from delivery and the luminance-signal processing circuit 42 through the multiplier control circuit 30 in the detected focal position signal in the optimal location based on delivery, a focal position signal, and a luminance signal to the focal control circuit 52 is outputted to the drive circuit 55 of the focal motor 58, and the focal lens 13 is controlled in the optimal location by driving the focal motor 58. Focal actuation is performed by the above actuation.

[0024] Next, zoom actuation is explained. The zoom location sensor 17 and the zoom location detector 37 detect the location of a zoom lens 12. The zoom position control signal which controls a zoom lens 12 for the luminance signal outputted to the zoom control circuit 53 from delivery and the luminance-signal processing circuit 42 through the multiplier control circuit 30 in the detected zoom position signal the optimal based on delivery, a zoom position sign and a luminance signal to the zoom control circuit 53 is outputted to the drive circuit 56 of the zoom motor 59, and a zoom lens 12 is controlled in the optimal location by driving the zoom motor 59. Zoom actuation is performed by the above actuation.

[0025] Next, iris adjustment actuation and the 1st quantity of light amendment actuation are explained. By the iris diaphragm value sensor 18 and the iris diaphragm value detector 39, the drawing value of an iris 15 is detected and t detected iris diaphragm value signal and the luminance signal outputted from the luminance-signal processing circui 42 are sent to the AGC control circuit 35 through the multiplier control circuit 30. When an iris 15 can adjust the amount of incident light not by the full open condition but by the iris 15, the AGC control circuit 35 An AGC contro signal with which the gain of AGC circuit 31 is set to 0 is outputted to the AGC drive circuit 34. The drawing value the iris 15 from which the video signal by AGC circuit 31 is not adjusted, but the level of a video signal becomes the optimal to the iris control circuit 51 Delivery, An iris control circuit outputs an iris control signal to the drive circuit based on this drawing value, and by driving the iris motor 57, an iris 15 is controlled so that the level of a luminance signal becomes the optimal. Next, when an iris 15 is opened fully and the amount of incident light cannot be adjusted with an iris 15, the AGC control circuit 35 outputs an AGC control signal with which the level of a luminance signal becomes the optimal to the AGC drive circuit 34, controls the gain of AGC circuit 31, and adjusts the level of a vide signal. The above actuation performs iris adjustment and 1st quantity of light amendment, and the level of a luminan signal is adjusted to the optimal condition.

[0026] Next, the 2nd quantity of light amendment actuation which amends the quantity of light fall of the periphery the image formation side by the 4th power rule of cosine and the vignetting is explained.

[0027] An example of the quantity of light distribution on CCD21 in drawing 2 is shown. Moreover, quantity of ligh distribution of section-A-A [at this time] ' and cross-section B-B' is shown in (a) of drawing 3 , and (b). The directio of A-A' of these drawings corresponds to the horizontal direction of a screen, and the direction of B-B' corresponds t the perpendicular direction of a screen. Drawing 2 and drawing 3 show that it is necessary to determine the correctio factor according to each point of a screen, in order to perform quantity of light amendment that the quantity of light difference of the periphery to the center section of the screen is not uniform, and perfect.

[0028] The quantity of light I of the periphery at this time is expressed with a degree type.
I=I0 and a-cos4 At theta top type, it is I0. It is the fall of the quantity of light are an include angle and according [a] a vignetting as which the quantity of light of a center section and a look at aperture efficiency, and theta looks at one point of a photographic subject from the core of incident light, and cos4. theta shows the fall of the quantity of light the 4th power rule of cosine. Aperture efficiency a is computable from the location of a zoom lens 12, the location of the focal lens 13, the drawing value of an iris 15, the configuration of each lens, and the location of CCD21, and sinc an include angle theta can substitute include-angle theta' seen from the core of incident light for the point on CCD21 which one point of a photographic subject corresponds, it can compute it from the configuration and location of CCD21. Since it is the value with which the configuration of each lens, the configuration of CCD21, and a location a values determined at the time of the design of the optical-system block 1, and the location of a zoom lens 12, the location of the focal lens 13, and the drawing value of an iris 15 are always detected by each detection means, it is th quantity of light I0 of a center section. The magnitude of the quantity of light I of the receiving periphery is computa with all the points. Therefore, the quantity of light I0 of a center section Multiplication can be carried out to the vide signal of a periphery by the ability making the inverse number of the magnitude of the quantity of light I of the receiving periphery into a correction factor, and level of the video signal of a periphery can be made equal to the leve of the video signal of a center section.

[0029] The correction factor computed to the quantity of light distribution shown in drawing 2 is shown in drawing 4 Moreover, the correction factor of cross-section C-C' at this time and cross-section D-D' is shown in (a) of drawing 5 and (b). The correction factor of the screen central point is 1.

[0030] The quantity of light distribution at the time of amending the quantity of light shown in drawing 2 and drawin 3 using the correction factor shown in drawing 4 and drawing 5 is shown in drawing 6 . Moreover, cross-section E-E drawing 6 and cross-section F-F' are shown in (a) of drawing 7 , and (b). As shown in drawing 6 and drawing 7 , it turns out that the fall of the quantity of light of a screen periphery is amended, it becomes equal to the quantity of lig of a center section, and the quantity of light of the whole screen has become homogeneity.

[0031] If the above-mentioned actuation is concretely explained in drawing 1 , based on the conversion position sign of CCD21 outputted from the CCD control circuit 45, the multiplier control circuit 30 will specify in which location electrical signal currently outputted from the present CCD 21 is on CCD21, and will ask for the present conversion location of CCD21. Include-angle theta' which looks at said conversion location from the core of incident light is computed, and the part by the 4th power rule of cosine of said amount formula of ambient light is calculated based o include-angle theta'. Next, the correction factor to the video signal which calculates the part by the vignetting of said amount formula of ambient light based on the luminance signal of the luminance-signal processing circuit 42, the drawing value signal of an iris 15, the position signal of the focal lens 13, the position signal of a zoom lens 12, and proper parameters, such as each lens which the memory section of the multiplier control circuit 30 is made to memor beforehand, and is finally changed into it on CCD21 is computed. Software performs the above-mentioned operation the CPU section of the multiplier control circuit 30, and through the multiplier output circuit 36, said correction facto is outputted to the multiplication circuit 33, and is carrying out multiplication to the current video signal.

[0032] By performing the above actuation serially, the fall of the amount of ambient light in each point on CCD21 ca be amended. Therefore, without the video signal outputted from the multiplication circuit 33 becoming uniform [the level of the whole screen], and the image quality of a periphery deteriorating compared with a screen center section, iris adjustment and 1st quantity of light amendment, since the level of a luminance signal is adjusted to best, very go image quality can be acquired.

[0033] Moreover, since CPU is used for the multiplier control circuit 30, and a correction factor is calculated by software, and it can respond also to modification of the proper parameter accompanying the design change of a lens easily and can respond to it by the same hardware to all models, share-izing and low-cost-izing of components can b attained.

[0034] Although the video signal changed into the digital signal is amended in this example, even if it amends the video signal of an analog signal, the same effectiveness can be acquired, and the same effectiveness can be acquired even if it constitutes the quantity of light amendment block 3 from an analog circuit. Moreover, although the correcti factor is computed by software, even if it uses the hardware of the dedication which consists of digital circuits etc., th same effectiveness can be acquired, the processing time at the time of calculation of a correction factor can be shortened further, and it becomes possible to perform highly precise quantity of light amendment.

[0035]

[Effect of the Invention] The location of the focal lens which changed the quantity of light of the image formation sid of image pick-up equipment into the electrical signal with the conversion means, outputted the video signal, and was detected by the 1st location detection means according to this invention as mentioned above, Based on the location o the zoom lens detected by the 2nd location detection means, and the drawing value of the iris detected by the diaphragm value detection means, by amending said video signal with an amendment means The quantity of light of the image formation side of image pick-up equipment can be amended completely, and it becomes possible to acquir good image quality. Moreover, since the quantity of light is amended electrically, it cannot be influenced [the configuration of the lens of optical system etc., and] of a configuration, but can apply also to small optical system, a it becomes possible to attain the miniaturization of equipment.

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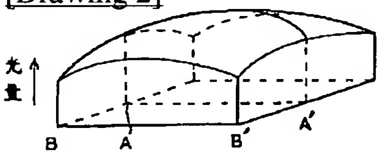
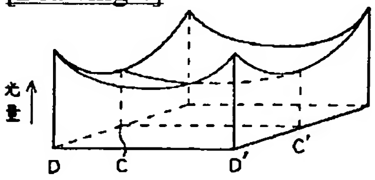
DRAWINGS

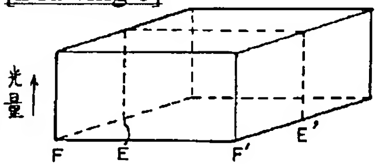
[Drawing 2]



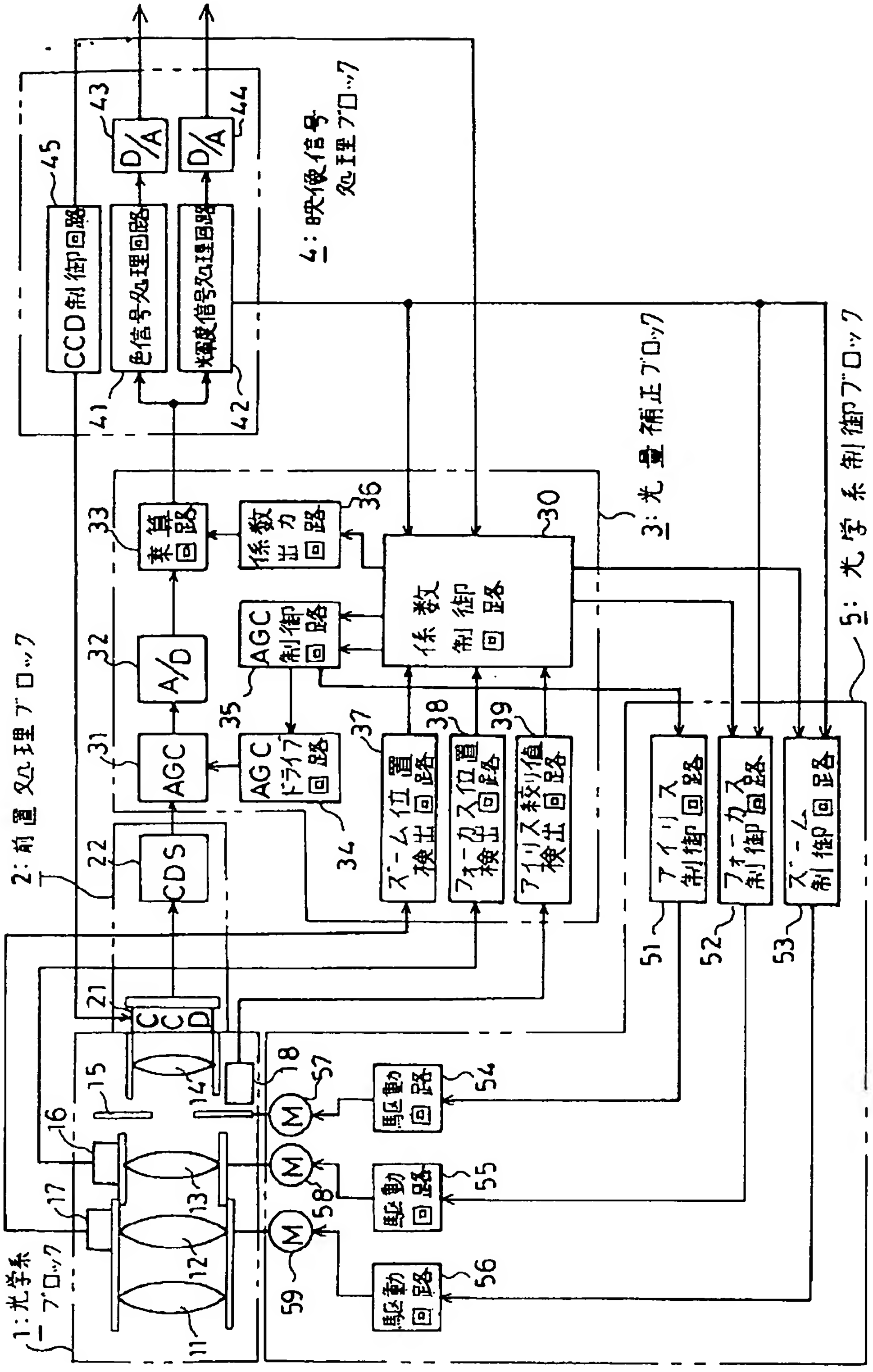
[Drawing 4]



[Drawing 6]



[Drawing 1]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色信号処理回路
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輝度信号処理回路
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D/A
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D/A
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乗算回路
33
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AGC
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A/D
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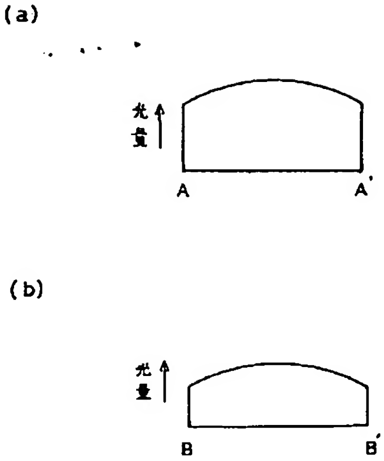
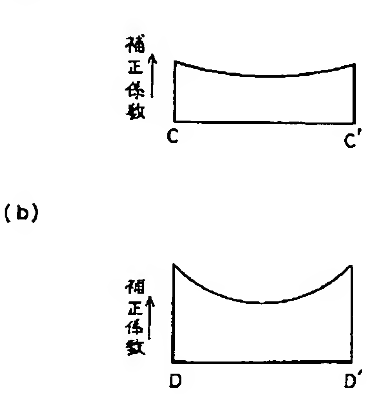
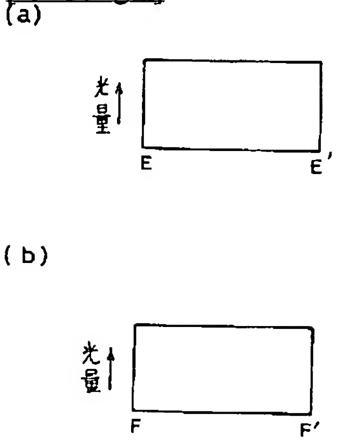
[Drawing 3]



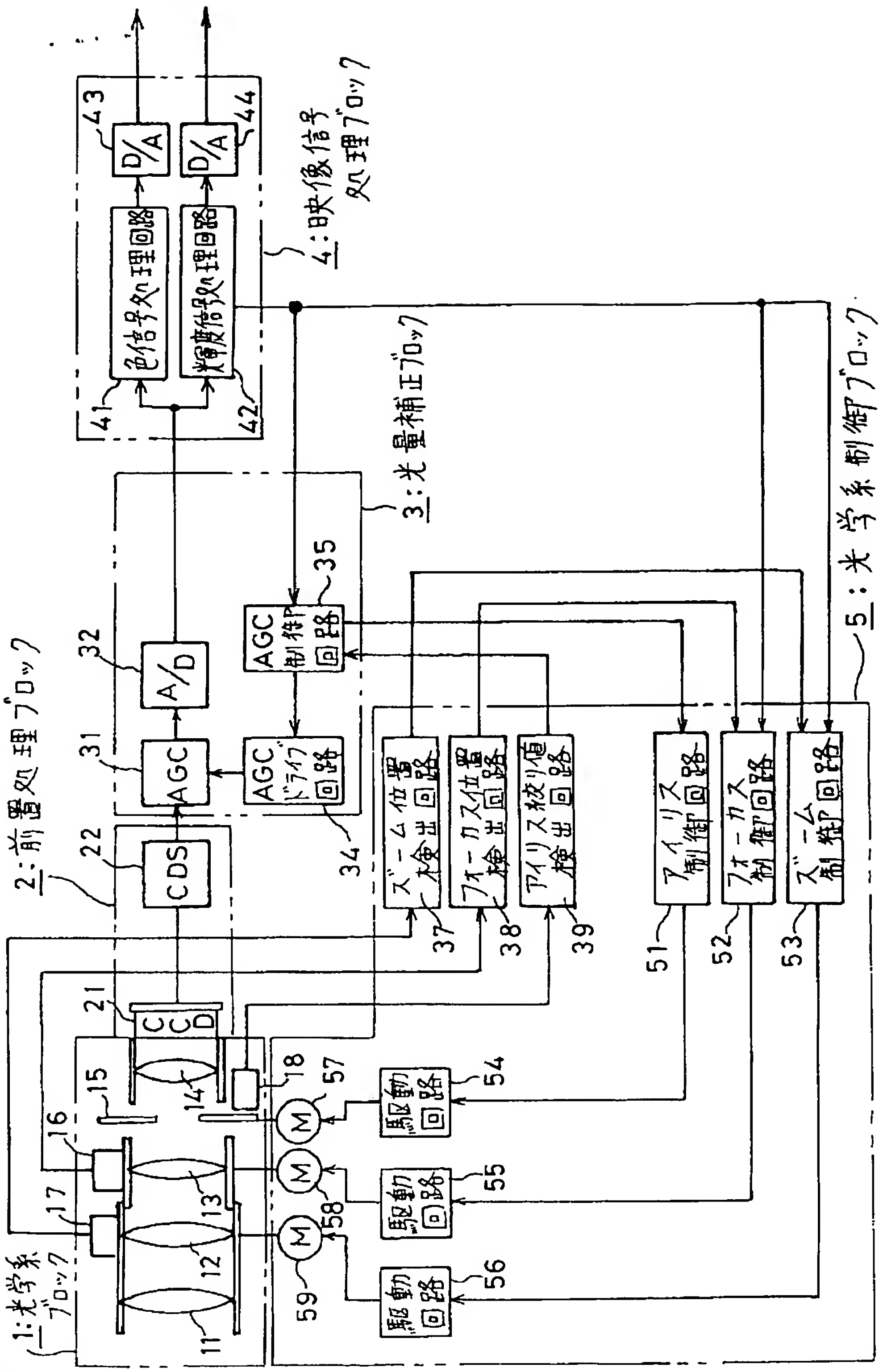
[Drawing 5]



[Drawing 7]



[Drawing 8]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CCD
22
CDS
31
AGC
32
A/D
34
AGCドライブ回路
35
AGC制御回路
37
ズーム位置検出回路
38
フォーカス位置検出回路
39
アイリス絞り値検出回路
41
色信号処理回路
42
輝度信号処理回路
43
D/A
44
D/A
51
アイリス制御回路
52
フォーカス制御回路
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ズーム制御回路
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